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ABSTRACT

Results of the 1981 Survey of Earned Doctorates, which is conducted by five federal agencies, are summarized. About 95 percent of the annual cohort of recipients of the Ph.D. and similar doctorates respond to the survey questionnaire. The database also includes some information on nonrespondents obtained from public sources; recipients of first-professional degrees (e.g., M.D.'s) are not included. Highlights are as follows: annual science and engineering (S/E) doctorate production increased over 2 percent to 17,600 between 1980 and 1981; S/E doctorates accounted for about 56 percent of all doctorates in 1981, approximately the level that has prevailed since 1973; decreases in doctorate production occurred in engineering and the physical sciences (both are down almost 30 percent over the decade), while psychology and the life sciences generally increased; the annual number of both U.S. and foreign S/E doctorate recipients generally declined over the 1971-1981 period, but the 13 percent decrease for U.S. citizens was almost twice as great as that for non-U.S. citizens; minority group members received about one-tenth of the S/E doctorates awarded to U.S. citizens and permanent residents in 1981; the sex composition of the new S/E doctorate recipients changed over the last 10 years, with the proportion of women increasing from 10 percent in 1971 to 23 percent in 1981; the majority of doctorates undertake employment following graduation but the loci of job opportunities have been changing; the proportion of S/E doctorates entering employment in academia fell from 60 percent in 1971 to 43 percent in 1981, while employment in nonacademic institutions, excluding government, grew from 25 to 40 percent. (SW)

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SCIENCE
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STUDIES HIGHLIGHTS

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Prepared in the Supply and Education Analysis Group, Division of Science Resources Studies

SCIENCE RESOURCES STUDIES HIGHLIGHTS

NATIONAL SCIENCE FOUNDATION WASHINGTON, D.C. 20550 SEPTEMBER 10, 1982 NSF 82-323

Science/Engineering Doctorate Production Increases in 1981; More New Doctorates Seek Nonacademic Positions

The Survey of Earned Doctorates is conducted annually by the National Research Council[1] for the National Science Foundation, the National Endowment for the Humanities, the National Institutes of Health, and the Department of Education. Approximately 95 percent of the annual cohort of recipients of the Ph. D. and similar doctorates respond to the survey questionnaire. The data base also includes some information for nonrespondents that is obtained from public sources. Recipients of first-professional degrees, e.g., M.D.'s, are not included.

Highlights

• Annual science and engineering (S/E) doctorate production increased over 2 percent to 17,600 between 1980 and 1981. It was, however, 7 percent below the peak reached in 1973. S/E doctorates accounted for about 56 percent of all doctorates in 1981, approximately the level that has prevailed since 1973.

• There were substantial field differences in S/E doctorate production trends over the last 10 years. The most notable were the decreases that occurred in engineering and the physical sciences, both down almost 30 percent over the decade. In contrast, psychology and the life sciences generally increased

• The annual number of both U.S. and foreign S/E doctorate recipients generally declined over the 1971-81 period, but the 13-percent decrease for U.S. citizens was almost twice as great as that for non-U.S. citizens. The share of S/E doctorates awarded to U.S. citizens declined in all fields except the life sciences and psychology. The sharpest decline was in engineering—from 70 percent in 1971 to less than 50 percent in 1981.

• Minority group members received approximately one-tenth of the S/E doctorates awarded to U.S. citizens and permanent residents in 1981. Asian Americans earned almost three-fifths of the degrees awarded to minorities, but their share has decreased somewhat over recent years as the numbers of Hispanics and blacks have increased.

• The sex composition of the new S/E doctorate recipients changed over the last 10 years—with the proportion of women increasing from 10 percent in 1971 to 23 percent in 1981. The number of S/E doctorates awarded to women more than doubled between 1971 and 1981 to about 4,000, while the number of S/E doctorates awarded to men fell by 20 percent to 13,600. The growth in the number of S/E doctorates awarded to women, however, was not sufficient to offset fully the decrease in the degrees awarded to men in 1981 compared with 1971.

• The majority of doctorates undertake employment following graduation but the loci of job opportunities have been changing. For S/E doctorates who had signed contracts or made similar commitments, the proportion entering employment in academia fell from 60 percent in 1971 to 43 percent in 1981; employment in nonacademic institutions, excluding government, grew from 25 percent to 40 percent. There was little change in the proportion entering government employment, approximately 15 percent.

• In 1981, almost 30 percent of the new S/E doctorates planned to undertake postdoctoral study, about the same proportion as in previous years. The propensity for postdoctoral study varied greatly by field but not by citizenship or sex. About 55 percent of the new life sciences doctorates and about 40 percent of those in the physical sciences planned postdoctoral study. These two fields accounted for over three-fourths of all S/E doctorates with postdoctoral study plans.

Trends in Doctorate Production

Doctorate production in all fields went through a cycle of growth and decline between 1971 and 1981. From 1971 to 1973 total doctorate production increased 6 percent and then declined 7 percent to 31,300 to 1981. In S/E fields doctorate production was essentially level from 1971 to 1973, and then declined by 7 percent to 17,600 in 1981.[2] Despite the decline in S/E doctorate production since 1973, the S/E share of total doctorates remained at approximately 55 percent.

[1] Additional information is available from the National Research Council's annual publication series, *Summary Report: Doctorate Recipients from U.S. Universities* (Washington, D.C.).

[2] This decline is also reported in National Science Foundation, "Trends in Science and Engineering Degrees, 1950 through 1980," *Science Resources Studies Highlights* (NSF 81-320) (Washington, D.C., October 7, 1981). That report utilized degree data from the National Center for Education Statistics (NCES). Inconsistencies between the Survey of Earned Doctorates (SED) and the NCES data may occur because of differences in data collection methods. Individuals furnish the SED data, while institutions furnish the NCES data.

Prepared in the Supply and Education Analysis Group, Division of Science Resources Studies.

The changes that occurred between 1971 and 1981 in total and in S/E doctorate production were the result of rather substantial, but offsetting, changes in the basic underlying factors. These were, first, changes in the pool of potential new doctorates and, second, changes in the fraction of that pool who actually acquired doctorates (table 11). The potential pool, defined as the number completing baccalaureates seven years earlier, doubled; the fraction acquiring doctorates (the "completion rate") fell dramatically—by approximately one-half for S/E and non-S/E degrees. These declines in completion rates reflect both the decrease in the fraction of the potential pool going on for advanced degrees and the shifting to graduate and professional training in fields such as law, business, and medicine.

Table 1. Trends in doctorate determinants

Field	1981		Percent change 1971-81	
	Potential pool[1]	Completion rate[2]	Potential pool	Completion rate
All science/engineering fields	305,000	6	+99	-53
Physical sciences[3]	21,000	15	+21	-41
Mathematical sciences	27,000	4	+42	-45
Engineering	44,000	8	+24	-41
Life sciences	88,000	7	+116	-51
Psychology	52,000	8	+291	-60
Social sciences	93,000	3	+152	-83
Non-science/engineering fields	704,000	2	+102	-48

[1]Number of baccalaureates granted in field seven years earlier (i.e., in 1984 and 1974).
[2]Number of Ph. D.'s granted per 100 in potential pool.
[3]Includes earth and environmental sciences.

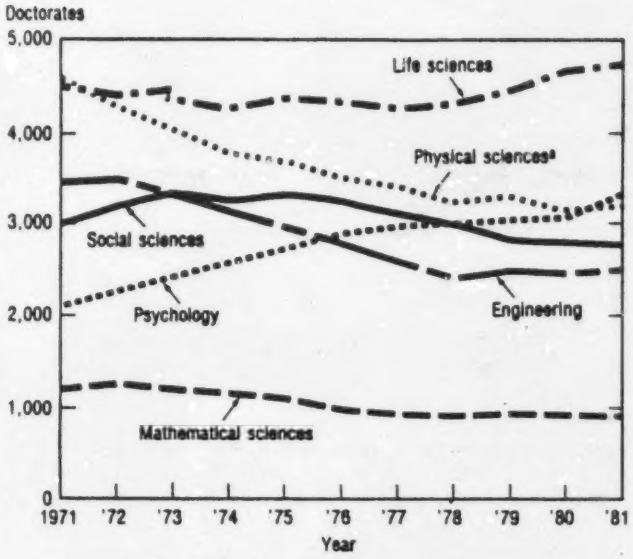
SOURCE: National Science Foundation

FIELD

There were substantial field differences in production trends during the seventies (chart 1). The most notable were the decreases that occurred in engineering and the physical sciences. In contrast, psychology and the life sciences generally increased over the decade, with the latter reaching an all-time high of 4,780 doctorates in 1981. As a consequence of differential growth, the share of S/E doctorates fell from 21 percent in 1971 to 15 percent in 1981 for the physical sciences, and from 18 percent to 14 percent for engineering. Psychology doctorates grew from 11 percent of all S/E doctorates in 1971 to 19 percent in 1981. Doctorates awarded in the life sciences increased from 24 percent in 1971 to 27 percent in 1981.

Differences in growth rates in baccalaureates are associated with a considerable amount of the field variation in S/E doctorate production trends. Fields with the largest 1971-81 growth rates in doctorate production were generally the fields with above-average rates of growth in these pools. In the field of life sciences, for example, the number of baccalaureates more than doubled between 1971 and 1981, fully offsetting the effects of the decline of about 50 percent in the completion rate. There was relatively less variation among fields in changes in completion rates than in changes in the size of the baccalaureate pool (table 1). Declines in these rates ranged between 41 percent for engineering and the physical sciences to 63 percent for the social sciences; increases in the pool ranged from 21 percent in the physical sciences to almost 300 percent in psychology.

Chart 1. Science/engineering doctorate production by field

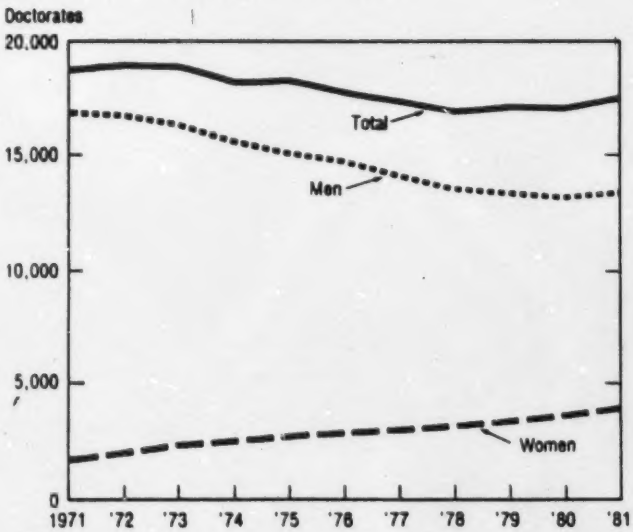


[a]Includes earth and environmental sciences.
SOURCE: National Science Foundation

SEX

Both the number and proportion of S/E doctorates awarded to women have been steadily increasing throughout the decade. The number of S/E doctorates awarded to women grew from 1,900 in 1971 or 10 percent of all such doctorates, to 4,000 in 1981 or 23 percent (chart 2). Over this same period S/E doctorates awarded to men fell by 20 percent to 13,600. Changes in the sex distribution of new S/E doctorates are related in part to the patterns of growth and decline in the S/E fields. Those fields with substantial proportions of women—psychology and the life and social sciences—were

Chart 2. Science and engineering doctorate production by sex



SOURCE: National Science Foundation

among those showing increases in the number of degrees earned, while those with lower proportions of women—engineering and the physical and mathematical sciences—were the fields in which the total number of doctorates fell. Women's representation, however, increased in all S/E fields, but the changes were not uniform. In 1981, as in 1971, the proportion of women was greatest in psychology (44 percent in 1981) and lowest in engineering (4 percent in 1981).

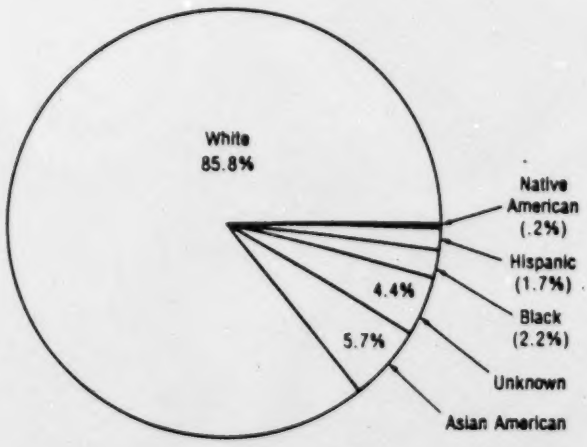
The faster 1971-81 growth of S/E doctorates awarded to women is the result of both the more rapid relative growth in the female pool and the less rapid decline in the female completion rate (table 1). The female pool for all S/E fields combined nearly tripled between 1971 and 1981. In terms of specific fields, the female pool more than doubled for every one except the physical and mathematical sciences, which increased by only 44 percent and 62 percent, respectively. The female completion rate for all S/E degrees fell by only 27 percent (compared with 55 percent for men); the field-specific declines in completion rates for females were less than those for males, and the female rate actually increased in engineering and the physical sciences. Except for engineering, where the number of doctorates awarded to women has been relatively small, the female completion rate was generally slightly lower than that for males, but the difference in completion rates between men and women narrowed between 1971 and 1981.

RACE

Among U.S. citizens and permanent residents, the number of S/E doctorates awarded to racial or ethnic minorities increased about 7 percent between 1975 and 1981.[3] (See 1981 data in chart 3.) The largest minority group among S/E doctorates was Asian Americans, approximately 5 percent in both 1975 and 1981. Blacks, the second largest minority group, and Hispanics, had substantial increases in numbers of S/E doctorates between 1975 and 1981 but their shares of the total were still relatively small. Since race/ethnic data are not regularly available for the pool of potential doctorates, it is not possible to analyze the determinants of these changes in degree production. (Non-U.S. citizens with temporary visas are not included in this analysis of race and ethnicity because the majority of them leave the United States after graduation and are not, therefore, part of the new supply of S/E doctorates for the U.S. labor market.)

[3] Racial/ethnic data were first collected in this survey in 1973, but some students used older versions of the questionnaire that year and the next. Therefore, the data comparisons here are limited to 1975 and 1981. Approximately 3 percent of the respondents did not provide information on race. This reported shift in the proportion of doctorates awarded to minorities holds regardless of assumptions made about the racial distribution of nonrespondents.

Chart 3. Racial/ethnic identity of U.S. citizen and permanent resident doctorates: 1981



SOURCE: National Science Foundation

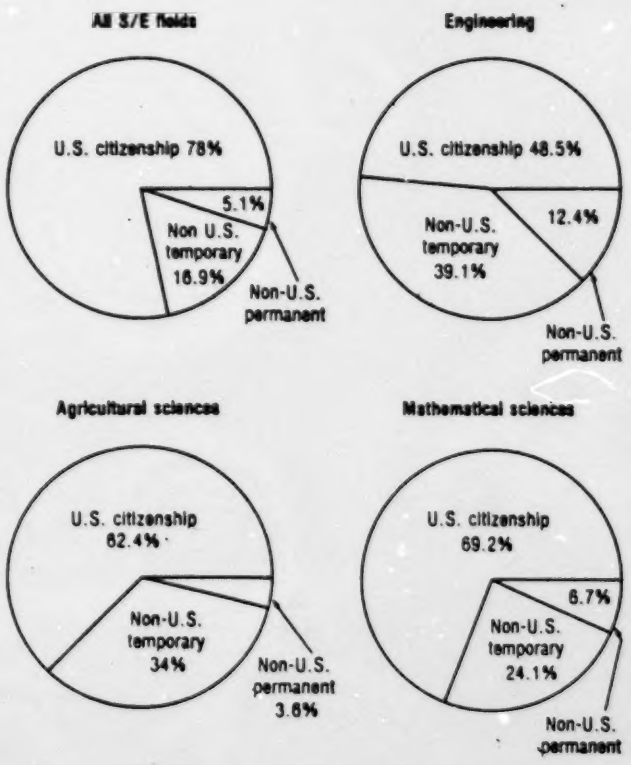
CITIZENSHIP

The share of S/E doctorates awarded to U.S. citizens has been declining. Compared to 1971, the number of U.S. citizens receiving S/E doctorates in 1981 was down 13 percent to 13,300. The proportion of U.S. citizens among S/E doctorates fell slightly over the period from 81 percent to 78 percent.[4]

Engineering was the field with the highest proportion of non-U.S. citizen doctorate recipients in 1981 (51 percent). Other fields in which foreign citizens accounted for relatively large shares of 1981 doctorates were agriculture (38 percent) and mathematics (31 percent) (chart 4). Because of current high demand for S/E employees, particularly in engineering, there is interest in the postdoctoral study and

[4] These percentages are based only upon S/E doctorates whose citizenship is known. Hence, these figures differ slightly from those shown in chart 4.

Chart 4. Citizenship status of 1981 science/engineering (S/E) doctorates for fields and substantial foreign participation



NOTE: Percentages based on doctorates whose citizenship is known.
SOURCE: National Science Foundation

employment plans of non-U.S. citizens with temporary visas. Overall, about 40 percent of the S/E non-U.S. doctorates with temporary visas had definite commitments in 1981 to stay in the United States after graduation, but over one-half (53 percent) of those in engineering had made arrangements to remain in the United States for postdoctoral study or employment.

Postgraduation Plans

Among U.S. citizens and permanent residents, slight shifts in postgraduation plans occurred. Although a majority of 1981 men and women S/E doctorates entered immediate employment (67 percent of men and 65 percent of women), these figures were slightly below those for 1971 S/E doctorates (73 percent of men and 68 percent of women). In turn, the percentage of men S/E doctorates undertaking postdoctoral study rose from 23 percent to 30 percent and that of women S/E doctorates from 27 percent to 32 percent.

EMPLOYMENT OF S/E DOCTORATES

Employment opportunities for new doctorates changed over the decade, particularly in the academic sector. In 1981 both S/E and non-S/E new doctorates were less likely to seek traditional academic employment, paralleling a shift in employment opportunity for the total S/E doctoral labor force.[1]

Of the U.S. citizens or permanent residents with employment commitments, 43 percent of the S/E doctorates in 1981—compared to 60 percent in 1971—indicated that they would be employed academically after graduation. Business and industry was the principal nonacademic employer (about 21 percent in 1971 and 30 percent in 1981), particularly among engineering and physical science doctorates. The fraction with definite commitments for academic employment dropped in all fields; in the physical sciences, for example, the share entering academic employment declined from 40 percent of 1971 doctorates to 13 percent of 1981 doctorates, and in the life sciences the proportion fell from 70 percent in 1971 to 55 percent in 1981.

POSTDOCTORAL STUDY

S/E doctorates constituted 90 percent of those entering postdoctoral study in 1981. Approximately one-third of all S/E doctorates chose this course. The life and physical sciences doctorates comprised three-fourths of the S/E doctorates undertaking postdoctoral study. In these fields 55 percent of the life sciences doctorates and about 40 percent of the physical sciences doctorates had such plans. The majority of those S/E doctorates intending to pursue postdoctoral study cited desire for additional research experience (56 percent) as their primary reason. The next most important reason was the desire to work with a particular scientist (20 percent). There was scant variation in the pattern of responses by field, the only exception being in psychology where 22 percent of the doctorates gave "other" as their primary reason for postdoctoral study. Postdoctoral internship requirements in psychology are a possible explanation for this anomaly.

Those who undertook immediate employment cited reasons for not taking a postdoctoral appointment. Both men and women S/E doctorates indicated that their primary reasons for not taking a postdoctoral appointment was the availability of an attractive employment opportunity (60 percent of men and 49 percent of women). Only 21 percent of all 1981 S/E doctorates—primarily those in psychology and mathematical, life, and social sciences—indicated that lack of opportunity for postdoctoral study prevented them from taking such an appointment.

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Detailed Statistical Tables on this subject will be available in late 1982.

[1] National Science Foundation, "Employment Opportunities for Ph. D. Scientists and Engineers Shift Away from Academia to Industry," *Science Resources Studies Highlights* (NSF 81-312) (Washington, D.C., July 24, 1981).